

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended): A face recognition method for identifying a person by detecting a three-dimensional shape of the person's face and a surface reflectance image thereof and collating the three-dimensional shape of the face and the surface reflectance image with enquiry face image data, comprising:

estimating shooting conditions of the enquiry face image data;

generating referential face image data based on the shooting conditions, the three-dimensional shape and an reflectance image of the surface thereof;

comparing the referential face image data to the enquiry face image data; and

identifying the person of the enquiry face image data with the person of the referential face image data based on a difference between the face image data.

2. (currently amended): A face recognition method having database which stores three-dimensional shapes of human faces and surface reflectance images thereof for identifying a person by collating the three-dimensional shape of the specific person's face and the surface reflectance image stored in the database with enquiry face image data, comprising:

estimating shooting conditions of the enquiry face image data;

generating referential face image data based on the shooting conditions, the three-dimensional shape and the surface reflectance image stored in the database;

comparing the referential face image data to the enquiry face image data; and
identifying the person of the enquiry face image data with the person of the referential face image data based on a difference between the face image data.

3. (previously presented): The face recognition method as claimed in claim 1, wherein the shooting conditions comprise an angle of the face image and a lighting direction, and the three-dimensional shape is specified by shape data and color image data.

4. (previously presented): The face recognition method as claimed in claim 2, wherein the shooting conditions comprise an angle of the face image and a lighting direction, and the three-dimensional shape is specified by shape data and color image data.

5. (original): A face recognition method as claimed in claim 1, wherein the referential face image and the enquiry face image are compared after locations of characteristic points, size and brightness of both the face image data have been normalized.

6. (original): A face recognition method as claimed in claim 2, wherein the referential face image and the enquiry face image are compared after locations of characteristic points, size and brightness of both the face image data have been normalized.

7. (original): A face recognition method as claimed in claim 3, wherein the referential face image and the enquiry face image are compared after locations of characteristic points, size and brightness of both the face image data have been normalized as parameters.

8. (original): A face recognition method as claimed in claim 4, wherein the referential face image and the enquiry face image are compared after locations of characteristic points, size and brightness of both the face image data have been normalized as parameters.

9. (currently amended): An object recognition method for identifying an object by detecting a three-dimensional shape of the object and a surface reflectance image thereof and collating the three-dimensional shape of the object and the surface reflectance image with enquiry image data, comprising:

estimating shooting conditions of the enquiry image data;

generating referential image data based on the shooting conditions, the three-dimensional shape and the surface reflectance image;

comparing the referential image data to the enquiry image data; and

identifying the object of the enquiry image data with the object of the referential image data based on a difference between the image data.

10. (currently amended): An object recognition method having database which stores three-dimensional shapes of a plurality of objects and surface reflectance images thereof for identifying an object by collating the three-dimensional shape of the specific object and the surface reflectance image stored in the database with enquiry image data, comprising:

estimating shooting conditions of the enquiry image data;

generating referential image data based on the shooting conditions, the three-dimensional shape and the surface reflectance image stored in the database;

comparing the referential image data to the enquiry image data; and

identifying the object of the enquiry image data with the object of the referential image data based on a difference between the image data.

11. (currently amended): A face recognition device for identifying a person by detecting a three-dimensional shape of the person's face and a surface reflectance image thereof and collating the three-dimensional shape of the face and the surface reflectance image with enquiry face image data, comprising:

an image input means for obtaining the enquiry face image by specifying shooting conditions of the enquiry face image data;

a graphics means for generating referential face image data based on the shooting conditions, the three-dimensional shape and the surface reflectance image; and

an image collating means for comparing the referential face image data with the enquiry face image data to evaluate the images; and

identifying the person of the enquiry face image data with the person of the referential face image data based on a difference between the face image data.

12. (currently amended): A face recognition device having database which stores three-dimensional shapes of a plurality of human faces and surface reflectance images thereof for identifying a person by collating the three-dimensional shape of the specific person's face and the surface reflectance image stored in the database with enquiry face image data, comprising:

a condition input means for specifying shooting conditions of the enquiry face image data to input, the database for storing the three-dimensional shape data of faces and the surface reflectance image data;

a graphics means for generating referential face image data based on the shooting conditions, the three-dimensional shape data and its surface reflectance image data stored in the database;

an image input means for obtaining the enquiry face image data; and

a image collating means for comparing and collating the referential face image data with the enquiry face image data, and identifying the person of the enquiry face image data with the person of the referential face image data based on a difference between the face image data.

13. (currently amended): A face recognition device as claimed in claim 11, wherein the surface reflectance image is a color image.

14. (currently amended): A face recognition device as claimed in claim 12, wherein the surface reflectance image is a color image.

15. (previously presented): The face recognition device as claimed in claim 11, wherein

the shooting conditions inputted to the condition input means comprise an angle of the face image and a lighting direction;

the image collating means comprises a normalizing means for normalizing the referential face image data and the enquiry face image data, respectively, using a standard face image as the basis; and

an image comparing means for comparing outputs of the normalizing means that comprise a normalized enquiry image and a normalized referential color image.

16. (previously presented): The face recognition device as claimed in claim 12, wherein

the shooting conditions inputted to the condition input means are an angle of the face image and a lighting direction,

the image collating means includes a normalizing means for normalizing the referential face image data and the enquiry face image data respectively using a standard face image as the basis; and

an image comparing means for comparing outputs of the normalizing means that comprise a normalized enquiry image and a normalized referential color image.

17. (previously presented): The face recognition device as claimed in claim 13,
wherein

the shooting conditions inputted to the condition input means are an angle of the face
image and a lighting direction,

the image collating means includes a normalizing means for normalizing the referential
face image data and the enquiry face image data respectively using a standard face image as the
basis and

an image comparing means for comparing outputs of the normalizing means that
comprise a normalized enquiry image and a normalized referential color image.

18. (previously presented): The face recognition device as claimed in claim 14,
wherein

the shooting conditions inputted to the condition input means are an angle of the face
image and a lighting direction,

the image collating means includes a normalizing means for normalizing the referential
face image data and the enquiry face image data respectively using a standard face image as the
basis and

an image comparing means for comparing outputs of the normalizing means that
comprise a normalized enquiry image and a normalized referential color image.

19. (currently amended): An object recognition device having database which stores three-dimensional shapes of a plurality of objects and surface reflectance images thereof for identifying an object by collating contents of the database with enquiry image data, comprising:

a condition input means for specifying shooting conditions of the enquiry image data to input, the database for storing the three-dimensional shape data of objects and the surface reflectance image data;

a graphics means for generating referential image data based on the shooting conditions, the three-dimensional shape data and its surface reflectance image data stored in the database;

an image input means for obtaining the enquiry image data; and

a image collating means for comparing and collating the referential image data with the enquiry image data, and identifying the object of the enquiry face image data with the object of the referential face image data based on a difference between the image data.

20. (previously presented): The face recognition device as claimed in claim 19, wherein

the shooting conditions inputted to the condition input means are an angle of the object and a lighting direction;

the image collating means includes a normalizing means for normalizing the referential image data and the enquiry image data respectively using a standard object image as the basis; and

an image comparing means for comparing outputs of the normalizing means that comprise a normalized enquiry image and a normalized referential image.

21. (currently amended): A recording medium storing a program being readable by a computer to operate a recognition method having database which stores three-dimensional shapes of a plurality of human faces and surface reflectance images thereof for identifying a person by collating contents of the database with enquiry face image data, wherein the program comprises:

estimating shooting conditions of the enquiry face image data;
generating referential face image data based on the shooting conditions, the three-dimensional shape and the surface reflectance image stored in the database;
comparing the referential face image data to the enquiry face image data; and
identifying the person of the enquiry face image data with the person of the referential face image data based on a difference between the face image data.

22. (previously presented): The recording medium as claimed in claim 21, storing a program being readable by a computer, wherein the shooting conditions comprise an angle of the face image and a lighting direction, and the three-dimensional shape is specified by shape data and color image data.

23. (currently amended): A recording medium storing a program being readable by a computer to operate a recognition method having database which stores three-dimensional shapes of a plurality of objects and surface reflectance images thereof for identifying an object by collating contents of the database with enquiry image data, wherein the program comprises:

specifying shooting conditions of the enquiry image data to input;

generating referential image data based on the three-dimensional shape and the surface reflectance image stored in the database;

obtaining the enquiry image data;

comparing and collating the referential image data with the enquiry image data; and

identifying the object of the enquiry image data with the object of the referential image data based on a difference between the image data.

24. (previously presented): The recording medium as claimed in claim 23, storing a program being readable by a computer, wherein the shooting conditions comprise an angle of the object image and a lighting direction, and the three-dimensional shape is specified by shape data and color image data.

25. (currently amended): A recording medium storing a program being readable by a computer to operate a recognition method for identifying an object by detecting a three-dimensional shape of the object and a surface reflectance image thereof and collating the three-dimensional shape of the object and the surface reflectance image with enquiry image data, wherein the program comprises:

estimating shooting conditions of the enquiry image data;

generating referential image data based on the shooting conditions, the three-dimensional shape and its surface reflectance image;

comparing and collating the referential image data with the enquiry image data; and

identifying the object of the enquiry image data with the object of the referential image data based on a difference between the image data.

26. (previously presented): The face recognition method as claimed in claim 1 wherein the referential face image data is generated by using a graphics means.

27. (previously presented): The face recognition method as claimed in claim 2 wherein the referential face image data is generated by using a graphics means.

28. (previously presented): The object recognition method as claimed in claim 9 wherein the referential image data is generated by using a graphics means.

29. (previously presented): The object recognition method as claimed in claim 10 wherein the referential image data is generated by using a graphics means.

30. (previously presented): The face recognition method as claimed in claim 21 wherein the referential face image data is generated by using a graphics means.

31. (previously presented): The recording medium as claimed in claim 23 wherein the referential image data is generated by using a graphics means.

32. (previously presented): The recording medium as claimed in claim 25 wherein the referential image data is generated by using a graphics means.

33. (previously presented): The face recognition method as claimed in claim 3, wherein the shooting conditions comprise a plurality of lighting directions.

34. (previously presented): The face recognition method as claimed in claim 4, wherein the shooting conditions comprise a plurality of lighting directions.

35. (previously presented): The face recognition device as claimed in claim 15, wherein the shooting conditions comprise a plurality of lighting directions.

36. (previously presented): The face recognition device as claimed in claim 16, wherein the shooting conditions comprise a plurality of lighting directions.

37. (previously presented): The face recognition device as claimed in claim 17, wherein the shooting conditions comprise a plurality of lighting directions.

38. (previously presented): The face recognition device as claimed in claim 18, wherein the shooting conditions comprise a plurality of lighting directions.

39. (previously presented): The face recognition device as claimed in claim 20, wherein the shooting conditions comprise a plurality of lighting directions.

40. (previously presented): The recording medium as claimed in claim 22, storing a program being readable by a computer, wherein the shooting conditions comprise a plurality of lighting directions.

41. (previously presented): The recording medium as claimed in claim 24, storing a program being readable by a computer, wherein the shooting conditions comprise a plurality of lighting directions.

42. (previously presented): The face recognition device as claimed in claim 15, wherein the normalizing means normalizes the location of characteristic points, size and brightness of both the referential face image data and the enquiry face image data.

43. (previously presented): The face recognition device as claimed in claim 16, wherein the normalizing means normalizes the location of characteristic points, size and brightness of both the referential face image data and the enquiry face image data.

44. (previously presented): The face recognition device as claimed in claim 17, wherein the normalizing means normalizes the location of characteristic points, size and brightness of both the referential face image data and the enquiry face image data.

45. (previously presented): The face recognition device as claimed in claim 18, wherein the normalizing means normalizes the location of characteristic points, size and brightness of both the referential face image data and the enquiry face image data.